Minutes of Meeting 1 of SC-186 Working Group 3
Development of MOPS for 1090 MHz ADS-B, Revision A

The meeting was held on 28-30 November 2000, at the MIT Lincoln Lab Liaison Office in Washington DC. The meeting was called to order at 9am 11/28/00 by Dr. Vince Orlando. Dr. Orlando gave some introductory remarks to include the fact that this is the same facility at which the initial meeting was held for the kickoff of the original 1090 MHz MOPS effort, over 2 years ago. Dr. Orlando welcomed all attendees and asked that each one introduce themselves and their organization. The attendees included:

Jerry Anderson, FAA – AIR-130	Greg Kuehl, UPS Airlines	Bob Saffell, Rockwell Colins
Pio Blankas, Honeywell	Ian Levitt, Titan Corp. (FAA TC – ACT-350)	Stu Searight, FAA TC – ACT-350
Cynthia Cyrus, Trios Assoc. (FAA Ctr)	James Maynard, UPS Aviation Tech.	Bob Semar, United Airlines
Gary Furr, Titan Corp. (FAA TC - ACT-350)	Vince Orlando, MIT Lincoln Lab	Rick Stead, ARINC, Inc.
Bob Granville, self	Kevin O'Toole, USAF Flight Std.	John Van Dongen, FAA TC – ACT-350
William Harman, MIT Lincoln Lab	Tom Pagano, FAA TC – ACT-350	Gene Wong, FAA – AND-530
Carl Jerierski, FAA TC – ACT-350	Paul Prisaznuk, AEEC/ARINC	
Ron Jones, FAA – ASD-140	Stacey Rowlan, L3 Communications	

1. Following introductions, Dr. Orlando gave a briefing entitled "Extended Squitter Update" summarizing developments since the last meeting of Working Group #3 (WG-3). Highlights of the presentation include:

   a. All of the technical requirements of Document 9688 (The Manual on Mode S Specific Services) have been converted into SARPS. Requirements are consistent with the published 1090 MOPS. Remaining Document 9688 material (guidance materials) will be contained in a new edition of Doc 9688. **Any WG-3 members who require a copy of this material can request it via email from Vince.** The original idea of converting Doc 9688 to a "Technical Manual" was not followed, since SICASP was informed that technical manuals have no standing in ICAO.

   b. DF=19 was added as a new squitter format for military applications. The DF=19 squitter contains at a minimum a 5-bit Downlink Format (DF), and a 3-bit Application Field (AF). SICASP approved DF=19 broadcast of Mode 1, 2 and 3/A codes as contained in the 1090 MOPS coded as AF=0 and Type Code=0.

   c. On-the-Ground validation check of 1090 MHz MOPS was added to the SARPS. It is required for aircraft with extended squitter capabilities, and is recommended for all aircraft.

   d. RTCA document DO-181B is to be revised to include the changes to the Mode S System SARPs approved at SICASP/7. Changes have already been incorporated into MOPS requirements and a copy is available. Changes to the test procedures are in process. We expect an SC-187 meeting in January to review these changes.

   e. Extended squitter performance and environmental measurements were made in Frankfurt in May 2000. Data collection flights were conducted on 5 days between May 19th and May 25th. Each party provided a project aircraft for the evaluation. Extended Squitter ground stations were located at Wiesbaden and Langen. Ground SSR and Mode S data were recorded in parallel. The FAA WJH Technical Center aircraft was equipped to collect 1030 MHz and 1090 MHz r.f. environmental data. All controlled aircraft (FAA, FII, NLR) were equipped to transmit, receive and record 1090 MHz Extended Squitters. Several British Airways aircraft equipped with Extended Squitter served as additional targets of opportunity. Detailed analysis of the data is now underway and is expected to continue into early 2001. An interim report is being published. **Any WG-3 members who require a copy of this material can request it via email from**

Vince. Because of the limited number of copies available, distribution will be limited to one per organization. A final report is planned for March 2001.

f. Regarding Acquisition of ID and Type --- it was intended to broadcast an additional ID and Type squitter every 5 seconds in conjunction with long range deconfliction application. Information was added to DO-260 Appendix A, but not into Section 2.2. The error was discovered too late to correct during the final MOPS review and publishing. The SARPS were made to be consistent with Section 2.2 of DO-260. WG-3 will need to revisit ID acquisition and make appropriate changes to Revision A.

g. A Quick Look Report will be made available about December 15, 2000 for the Louisville Op Eval 2.

2. Ronnie Jones presented a paper entitled "Proposed MOPS Enhancement to 1090 MHz ADS-B System for Extended Target Re-Acquisition."

a. The basic premise of the presentation was that "the current 1090 MOPS provides for dropping target tracks after having been coasted for 24 seconds. Measurements of the actual 1090 MHz extended squitter reception performance suggest that the overall system performance, and associated operational utility, could be improved by allowing the 1090 MHz ADS-B avionics to retain target information for a time period on the order of 120 to 240 seconds. This would permit the expedited re-acquisition of the target aircraft subsequent to a 24 second, or greater, gap in the reception of a position or velocity squitter." The specific issue is the need to perform a new global decode if no position report is received for 24 seconds. The global decode is ambiguous over 60 miles, so a validity time of 120 seconds for a global decode is appropriate.

b. Bob Saffell pointed out that the current 1090 MOPS in Section 2.2.10.3.1 already accounts for retaining data for up to 200 seconds if you do not receive a position squitter for more than 25 seconds.

c. After review and discussion, a change was approved to Figure 2-16b. While in the Acquisition State, if no position message has been received for **120** seconds, you will return to the Initialization State (and perform a global decode). And, an error in Figure 2-16b was corrected to indicate that while in the Track State, if no position or velocity message has been received for 25 seconds, there is a return to the **Acquisition State**. Changes to the text of Sections 2.2.10.3.1.f and 2.2.10.3.2.f were also suggested, to be consistent with the changes to Figures 2-16b and 2-16c. Corresponding changes will also be made in Sections 2.4.10.3.1 and 2.4.10.3.2 for tests of these conditions. Vince Orlando was given **Action Item 1-2** to provide technical support for these changes, and to show that a validity time for a global decode of 120 sec will not result in decode position ambiguity.

3. Stacey Rowlan of L3 Communications presented a CD-ROM based video of flights during the Louisville KY Op Eval 2.

4. Gary Furr began the review of items which were considered "Open Issues from the Initial 1090 MOPS Effort." These items were collected starting during the 'Post-Plenary Ad Hoc CPR Committee" discussions and continued with official comments submitted by EUROCAE and Eurocontrol some of which were discussed at the October SC-186 Plenary.

a. Tables 2-119 and 2-120 (DO-260 pages 486/487) have the same title. Tables 2-144, 2-145 and 2-146 (DO-260 pages 531/532) have the same titles. New titles were suggested by Gary Furr and were agreed upon by the Working Group. Gary will implement those changes in DO-260A.

b. A list of issues was submitted by Bev Nichols on behalf of Eurocontrol that related to the approval of the European document ED-102.

I. Sections 2.2.5.1.19, 2.2.5.2, 2.4.5.1.19 and 2.4.5.2 were labeled as "Unused Section." In DO-260 these sections were labeled as "Unused" in order to avoid extensive re-numbering of sections at the last moment prior to publication. WG-3 agrees that these sections will remain so titled until such time as the decision is made to undertake the process of re-numbering the entire document. This decision will not be made lightly.

II. In Table 2-64, in Notes 2 and 5, there were some spaces between letters of otherwise continuous words. WG-3 agrees that these editorial changes will be made in DO-260A.

III. In Table 2-73, Note 3 makes reference to an incorrect section. WG-3 agrees that the correct section number referenced in Note 3 should be 2.2.8.1.1.1, which will be corrected in DO-260A.

IV. In Table 2-76, Eurocontrol questioned that the correct Minimum Number of Participant Track Files for Equipage Class A3 is 400. WG-3 agrees that this is correct as published.

V. In Table 3-2, Eurocontrol questioned the correctness of an asterisk (*) being placed next to the word "Desired" in the A3+ Equipage Class. WG-3 agrees that there was an error in copying Table 3-2 from DO-242, Table 3-2a. WG-3 further believes that the best way to clear confusion concerning the note to which the asterisk should refer is to remove the asterisks from Table 3-2 and replace them with a "Note." WG-3 further agreed that in order to correct a possible error with Table 3-2a in DO-242, WG-3 will suggest to the Ad Hoc Committee for DO-242A that the text of the "Note" below Table 3-2a be changed to read "Forward direction coverage. Port and starboard coverage may be one half of this value; aft coverage may be 40 NM."

VI. In Table A-13 (copied from Table 2-54), Eurocontrol questioned the consistency of the entries for En Route Operational Capabilities encoding of Bits 9, 10, 11 and 12. After explanations concerning the reason why the entries were set as published in DO-260, WG-3 suggested altering the entries in Tables 2-54 and A-13, and suggested review of this issue by the Ad Hoc MASPS Committee. Further, changes to Test Procedures in Section 2.4.3.2.7.3.3.1 will be made in DO-260A to reflect the changes to Tables 2-54 and A-13 as follows:

Bits 9,10,11,12	Meaning
0 0 0 0	TCAS not Operational; CDTI not Operational or unknown
0 0 0 1	TCAS not Operational; CDTI Operational
0 0 1 0	TCAS Operational; CDTI not Operational or unknown
0 0 1 1	TCAS Operational; CDTI Operational

c. A list of primarily typographical and editorial issues was received just prior to the SC-186 October Plenary from Enrico Pupillo of Marconi. These issues were reviewed at the time of Plenary by Bob Saffell of Rockwell and agreed upon. All issues were again reviewed by WG-3 and again agreed to be valid typos within the published DO-260. WG-3 agreed that corrections will be made to DO-260A.

d. During review of draft DO-260 after the June Plenary, Steve Ashley expressed concern over the use of references to ARINC 429 Labels. In the months following publication of DO-260, and in a recent meeting of the AEEC General Assembly, Steve Ashley had withdrawn his concerns.

However, upon review of all references to ARINC 429 Labels in DO-260, WG-3 has agreed that the reference to GPS:076 should be removed from Figure A-6. WG-3 agrees that this change will be made in DO-260A.

e. Ian Levitt pointed out an error in the last entry in Table 2-90, designed for the verification of the NL Transition Table. WG-3 reviewed the entries in Table 2-90 and discussed the reason why Ian believed that the last entry should be changed. WG-3 agreed that the last entry in Table 2-90 was in error and agreed to the value suggested by Ian Levitt as the corrected entry. WG-3 agrees that this change will be made in DO-260A.

f. Jim Maynard and others suggested after the June Plenary that columns should be added to Tables 2-89, 2-90 and 2-91 to represent the values in Hexadecimal format. WG-3 agreed that this is recommended and **Action Item 1-3** was issued to Ian Levitt to provide Angular Weighted Binary (AWB) values in Hexadecimal format for inclusion in these tables for DO-260A.

g. Following the June Plenary, Tom Pagano disagreed with the implementation of the Plenary to delete Step 3 of Test Procedure 2.4.3.2.1.1.2., which included references to "FS" and "VS." After discussion, WG-3 agreed that because of the pending changes to DO-181B, it would be appropriate to issue **Action Item 1-1** to Tom Pagano to present proposed changes to DO-181B to ensure proper testing of "FS" and "VS" in DO-181C instead of proposing changes to DO-260A.

h. During the post-plenary review of the CPR equations, David Glessner of Rockwell Collins had proposed what he believed to be a simpler method for CPR encoding. After discussion by WG-3, it was decided that it would be inappropriate to make changes to DO-260 to accommodate this method. WG-3 therefore has rejected this suggestion for changes to CPR.

i. The Test Procedure in section 2.4.4.3.5 was generated after the June Plenary when it was discovered that no test procedure had been reviewed at Plenary. The necessity for expanding or making major changes to the Test Procedure in section 2.4.4.3.5 was delayed by WG-3 until we have a clearer view of the requirements for improved reception techniques.

j. Following the June Plenary and review of the draft 1090 MOPS, Jean-Michel Bonnet expressed concern over the number of TCPs available. After discussion, WG-3 agreed that the current DO-260 document is in compliance with the published DO-242 MASPS document. Pending review of this issue by the Ad Hoc MASPS Update Committee, and any modifications suggested in DO-242A, WG-3 will continue to comply with any requirement set forth regarding the number of TCPs.

5. Vince Orlando presented an outline of his thoughts on how to test the enhanced reception techniques in a document entitled "Issues/Considerations for Extended Squitter Enhanced Reception Performance MOPS." WG-3 discussed each bullet in the document that accompanies the distribution of these minutes in a file entitled "**Enhanced-Surv-MOPS.doc**." Items where WG-3 disagreed with the bullet during discussion have been marked "(not agreed)." Bill Harman additionally presented some graphs entitled "Extended Squitter Bench Tests," that showed the performance of UPSAT LDPUs as tested at JHU APL. Bill Harman and Tom Pagano were given **Action Item 1-4** to examine APL data on Extended Squitter Bench Tests to show that testing with the same power levels for multiple ATCRBS interferers is an adequate test. Ron Jones suggested that we might want to add an Appendix about other methods (other than more advanced message processing techniques) for improving performance at long range. E.g., directional antennas might be used, since the required performance is greater in the forward direction than abeam or aft for the longer range, at least for the higher equipage classes. For his suggestion Ron was rewarded with **Action Item 1-8**.

6. Vince Orlando presented a paper entitled "1090 MOPS Support for TIS-B," together with rough drafts of TIS-B 1090 MHz message formats. Vince took **Action Item 1-9** to revise the TIS-B formats to include comments from the meeting.

7. During the June Plenary, many issues that were brought up for discussion were agreed to have been issues that should be dealt with in a change to the MASPS document, RTCA/DO-242. A complete list of these "MASPS Issues" were retained and sorted by DO-260 Section number to produce the document that accompanies the distribution of these minutes in a file entitled **1090MASPS-Issues.doc**. This file has been annotated to include notes of discussions of WG-3 and the recommendations of WG-3 regarding whether or not WG-3 feels that the comment should be considered by the Ad Hoc Committee for review of the MASPS.

The meeting was called to an end with the review of the Action Items, shown in the table below. The next meeting of WG-3 will begin at 9am on January 30, 2001 in a conference room to be arranged by Bob Saffell in the Hilton Melbourne Beach Resort in Melbourne Florida. WG-3 immediately demanded a recount, and adjourned!

Action Number	Action Description	Assigned to	Status
1-1	Review the test procedures in DO-181B and DO-260 with respect to "FS" and "VS" and make a recommendation for changes to either document.	Tom Pagano	
1-2	Propose technical support for a change to the condition for performing a new global decode to change from 25 seconds to 120 seconds.	Vince Orlando	
1-3	Add values for Hex AWB for values in Tables 2-89, 2-90 and 2-91.	Ian Levitt	
1-4	Examine APL data on Extended Squitter Bench Tests to show that testing with the same power levels for multiple ATCRBS interferers is an adequate test.	Harman/Pagano	
1-5	Describe how the different enhancements are tested in different ways, with a different set of characteristics.	Stacey Rowlan	
1-6	Revisit Appendix I	Orlando/Harman	
1-7	Compare performance of their non real-time test sets.	MIT/FAATC	
1-8	Consideration on an additional Appendix to identify other methods of achieving enhanced reception.	Ron Jones	
1-9	Revise TIS-B formats to include comments from 1090 meeting 11/29/00	Vince Orlando	

Proposed dates and places for future meetings of the 1090 MHz MOPS Rev. A Working Group 3:

Dates/Time	**Meeting Place**
Tuesday, January 30 at 9am through noon, Friday, February 2	Hilton Melbourne Beach Resort, hosted by Rockwell Collins 3003 North A1A, Indialantic, FL, reservations: 321-777-5000 **Rooms will be set aside at the hotel at a special corporate rate.**
Tuesday, March 20 at 9am through noon, Friday, March 23	Confirmed at Phoenix Arizona hosted by L3 Communications **ACTUAL HOTEL YET TO BE CONFIRMED by Stacey Rowlan**
Monday, May 14 at 9am through noon, Friday, May 18	Suggested at Genoa, Italy hosted by Marconi **YET TO BE CONFIRMED**
Tuesday, July 10 at 9am through noon, Friday, July 13	Meeting place open for consideration. Default location at RTCA, in Washington, DC